COMPOSITION OF AN ILLINOIAN-AGE GLACIAL KAME TERRACE IN THE BREMEN CREEK VALLEY FAIRFIELD COUNTY, OHIO

Senior Thesis--Completed in fulfillment of the requirements for the Bachelor of Science Degree at The Ohio State University

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TABLES AND PLATES

TABLE OF CONTENTS

INTRODUCTION

Purpose

This report is the product of a study of the gravel deposits of an Illinoian-age glacial kame terrace remnant located in the valley east of Lancaster, Ohio. The pebbles are analyzed according to sphericity, roundness and lithology and the data is interpreted. The results of this report may be used in conjunction with similar investigations to assist in a greater understanding of the geology of the area.

Location And Description

The Illinoian kame terrace remnant is located in the northeast quarter of Section 11 of Berne Township in Fairfield County, Ohio. It is situated on the south side of the valley formed in pre-glacial time by the west-flowing Bremen Creek, which joined the Logan River at Lancaster (Stout, Ver Steeg, and Lamb, 1943).

The terrace remnant, at the time of my research, was being excavated for its gravel on two levels. The gravel of the upper level includes both pebbles and cobbles and for the most part is firmly cemented with secondary carbonates. This layer is approximately ten feet thick and caps the entire terrace remnant. The lower level contains gravel of both pebble and cobble sizes along with a large amount of

poorly stratified sand. This unconsolidated layer is approximately 14 feet thick and extends in all probability to an even greater depth, (Plate 6, Fig. 4).

An easterly flow of Illinoian meltwater is indicated by the variation in size of the pebbles from coarse gravel three miles east of Lancaster to fine gravel and stratified sand east of Bremen. Further evidence of this eastward flow is the decrease in elevation of the terrace surfaces in that direction, (Conley, 1956).

Procedure

Seven-hundred pebbles were collected within the terrace remnant at three distinct locations, (See Plates V and VI). Four-hundred pebbles were collected from the lower level near the center of the terrace at approximately 30 feet below the surface at Location I. Locations II and III in the upper level yielded 100 and 200 pebbles respectively. Collection of samples from this upper level was restricted by dense cementation. Location II was near the top of the terrace approximately six feet below the soil zone and Location III was in the same layer but at a lower elevation toward the eastern perimeter of the terrace remnant.

All samples were taken from freshly excavated surfaces or from areas with no evidence of slump. The pebbles studied ranged in size from 24 to 60 millimeters along their longest axis. Analysis of the samples included the determination of sphericity, roundness and lithology.

Analysis of Lithology

The gravel from each location was classified according to the three rock types: carbonates, clastics, and crystallines. These categories are subdivided as follows:

I Carbonates
- Dolostone
- Limestone (light and dark)
- Chert

II Clastics
- Sandstone (gray and brown)
- Shale

III Crystallines
- Igneous
  - Granitic (Acidic)
  - Dioritic (Basic)
- Metamorphics
  - Quartzitic
  - Gneissic
  - Tillite

The number of pebbles collected from each location and their percentages are recorded in Table I. The last two columns are reserved for the combined totals of all three locations. This system was chosen because of two basic properties, simplicity of categories and rapid interpretation. The categories are diverse enough to accept virtually all the samples collected but also small enough to allow accurate and intelligent comparisons.

The stone count shows an approximate equal distribution of carbonates and clastics along with a much lower number of crystallines. Carbonates accounted for an average of 44.29%, Clastics 41.43% and crystallines 14.28% of the 700 pebbles studied. The largest amount of carbonates was at Location III

TABLE I

ILLINOIAN KAME TERRACE LITHOLOGY

	LOCATION I		LOCATION II		LOCATION III		ALL LOCATIONS	
	Number of Pebbles	Percentage	Number of Pebbles	Percentage	Number of Pebbles	Percentage	Number of Pebbles	Percentage
I Carbonate								
Dolostone	24	6.00	2	2.00	8	4.00	34	4.86
Limestone (Light)	69	17.25	19	19.00	48	24.00	136	19.43
Limestone (Dark)	55	13.75	12	12.00	28	14.00	95	13.57
Chert	23	5.75	9	9.00	13	6.50	45	6.43
Total Carbonate Rock	171	42.75%	42	42.00%	97	48.50%	310	44.29%
II Clastic								
Sandstone (Gray)	70	17.50	14	14.00	34	17.00	118	16.86
Sandstone (Brown)	91	22.75	27	27.00	40	20.00	158	22.57
Shale	10	2.50	-	-	4	2.00	14	2.00
Total Clastic Rock	171	42.75%	41	41.00%	78	39.00%	290	41.43%
III Crystalline								
Igneous		5.00		5.00		3.50		4.57
Granitic (Acidic)	12		2		-		14	
Dioritic (Basic)	8		3		7		18	
Metamorphic		9.50		12.00		9.00		9.71
Quartzitic	32		11		16		59	
Gneissic	4		1		2		7	
Tillite	2		-		-		2	
Total Crystalline Rock	58	14.50%	17	17.00%	25	12.50%	100	14.28%
Total Stone Count	400	100.00%	100	100.00%	200	100.00%	700	100.00%

with 48.50%. The smallest amount of carbonates, 42.00% came from Location II. Clastics varied the least with the high at Location I, 42.75% and the low at Location III, 39.00%. The highest percentage of crystallines were extracted from Location II, 17.00%, and the lowest percent at Location III with 12.50%.

The lithology through the kame terrace is very uniform containing only slight variations. All three locations are consistant with the average, varying less than three percent, with only two exceptions. The brown sandstone at Location II varies 4.43% and the light limestone at Location III varies 4.60% from the average. Shale was not collected from Location II and Granitic (acidic) rock was not collected from Location III.

The most unusual pebbles found were two Gowganda tillites at Location I formed during the Huronian epoch of the Pre-Cambrian era. Their origin is in the vicinity of Cobalt, Ontario. Tillites were not found in either of Locations II and III.

Analysis of Roundness

Roundness of a pebble is the ratio of the average radius of curvature of the corners to the radius of curvature of the largest inscribed circle, (Krumbein, 1941). Plate I represents the various degrees of roundness from .1, very angular to .9, very smooth.

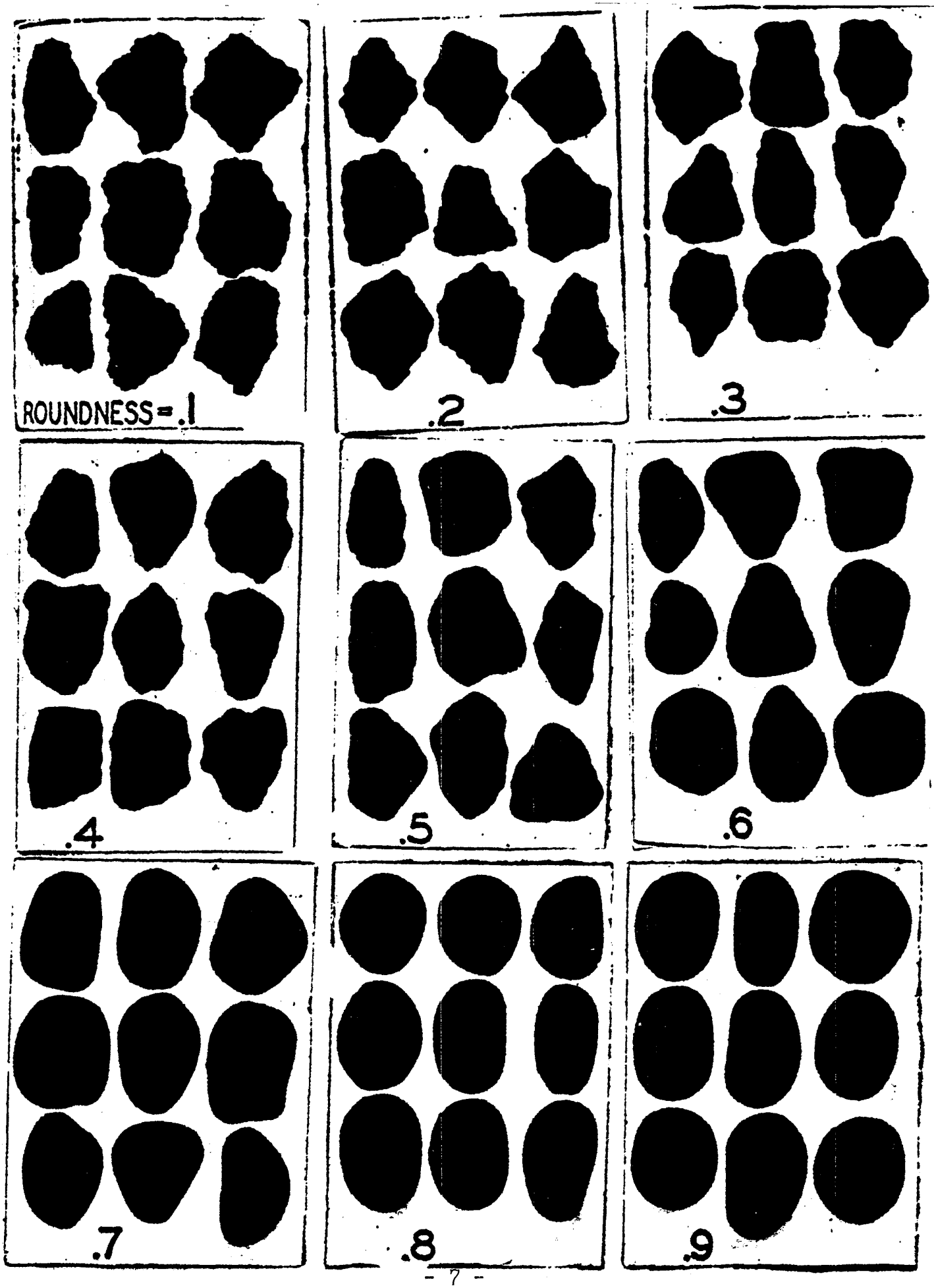
The mean roundness of the pebbles collected is recorded

TABLE II

MEAN ROUNDNESS

	LOCATION I	LOCATION II	LOCATION III	TOTAL MEAN ROUNDNESS
I Carbonate				
Dolostone	.57	.50	.44	.50
Limestone (Light)	.59	.57	.63	.60
Limestone (Dark)	.61	.62	.63	.62
Chert	.40	.42	.48	.43
Mean Roundness Carbonates	.54	.53	.55	.54
II Clastic				
Sandstone (Gray)	.62	.61	.66	.63
Sandstone (Brown)	.63	.63	.62	.63
Shale	.66	-	.58	.62
Mean Roundness Clastics	.64	.62	.62	.63
III Crystalline				
Igneous	.57	.68	.49	.58
Metamorphic	.61	.55	.62	.59
Mean Roundness Crystallines	.59	.62	.56	.59
Total Mean Roundness	.58	.57	.57	.57

PLATE I



according to rock type in Table II. The carbonates average roundness was .54. Chert was the most angular averaging .43 and dark limestone was the smoothest averaging .62. The clastics were the most consistent varying no more than .04 from the average .63. Shale was not collected from Location II. The crystallines average roundness was .59 but the igneous values varied considerably. The highest roundness value for igneous rock was .68 at Location II and the lowest value was .49 at Location III. The total mean roundness for the kame terrace was .57.

Analysis of Sphericity

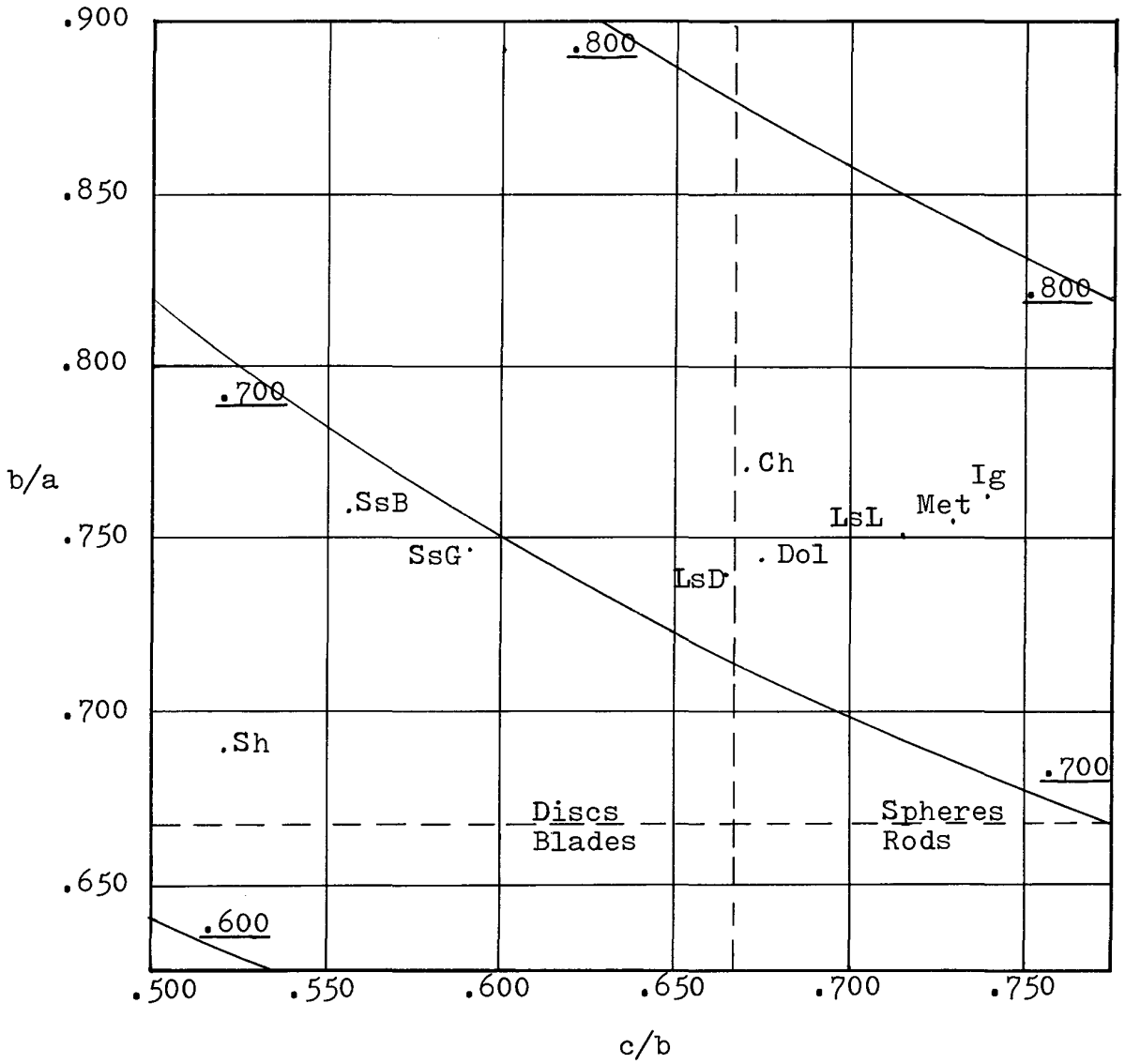
Sphericity is the shape or measure of the ratio of the surface of a pebble to its volume and is entirely independent of roundness, (Krumbein, 1941). The three diameters of a pebble, long (a), intermediate (b), and short (c) are measured. The ratio of the intermediate to long diameter (b/a) and the ratio of the short to the intermediate diameters (c/b) are plotted on sphericity charts. Mean sphericity charts for all three locations are on Plates II, III and IV, (modified from Killius 1971, modified from Krumbein 1941). The sphericity values are calculated by interpolation between the diagonal lines labeled .600, .700 and .800.

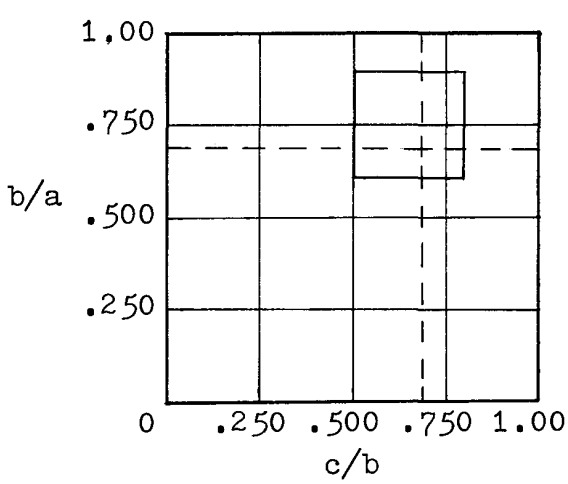
The crystallines were sphere shaped and consistent from each location with a mean sphericity of .768. The clastics must be divided into two sections for proper analysis. The disc-shaped sandstones mean sphericity was .708, however, the

PLATE II

MEAN SPHERICITY

LOCATION I





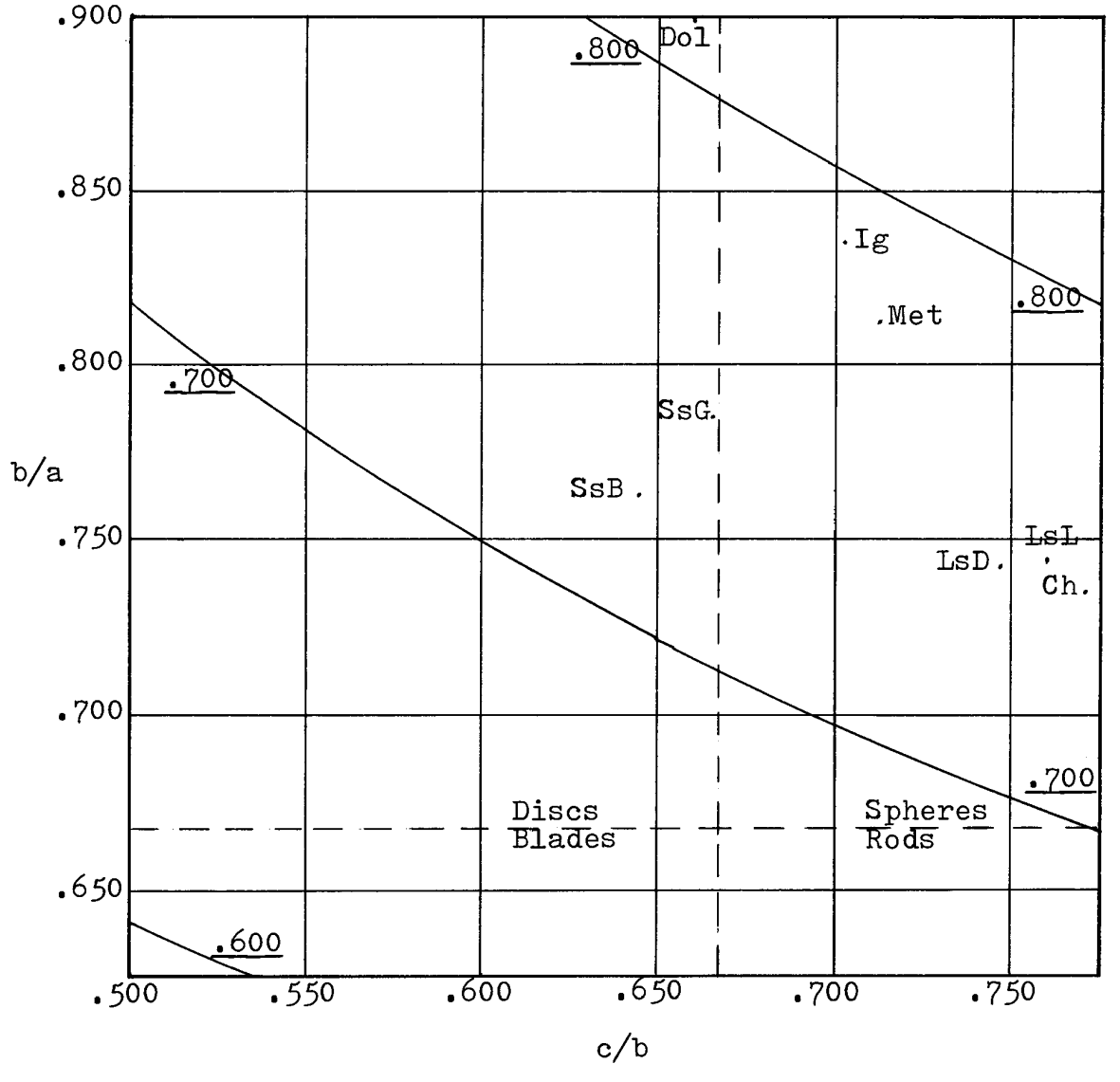
EXPLANATION

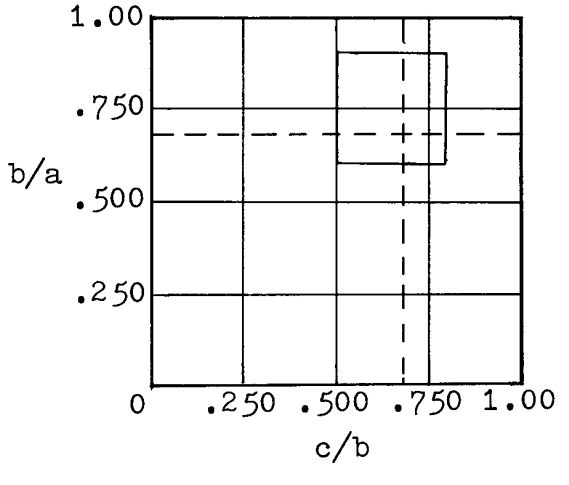
Ch . . . Chert
Dol . . . Dolostone
Ig . . . Igneous
LsD . . . Limestone (Dark)
LsL . . . Limestone (Light)
Met . . . Metamorphic
SsB . . . Sandstone (Brown)
SsG . . . Sandstone (Gray)
Sh . . . Shale

PLATE III

MEAN SPHERICITY

LOCATION II





EXPLANATION

Ch . . . Chert
Dol . . . Dolostone
Ig . . . Igneous
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LsL . . . Limestone (Light)
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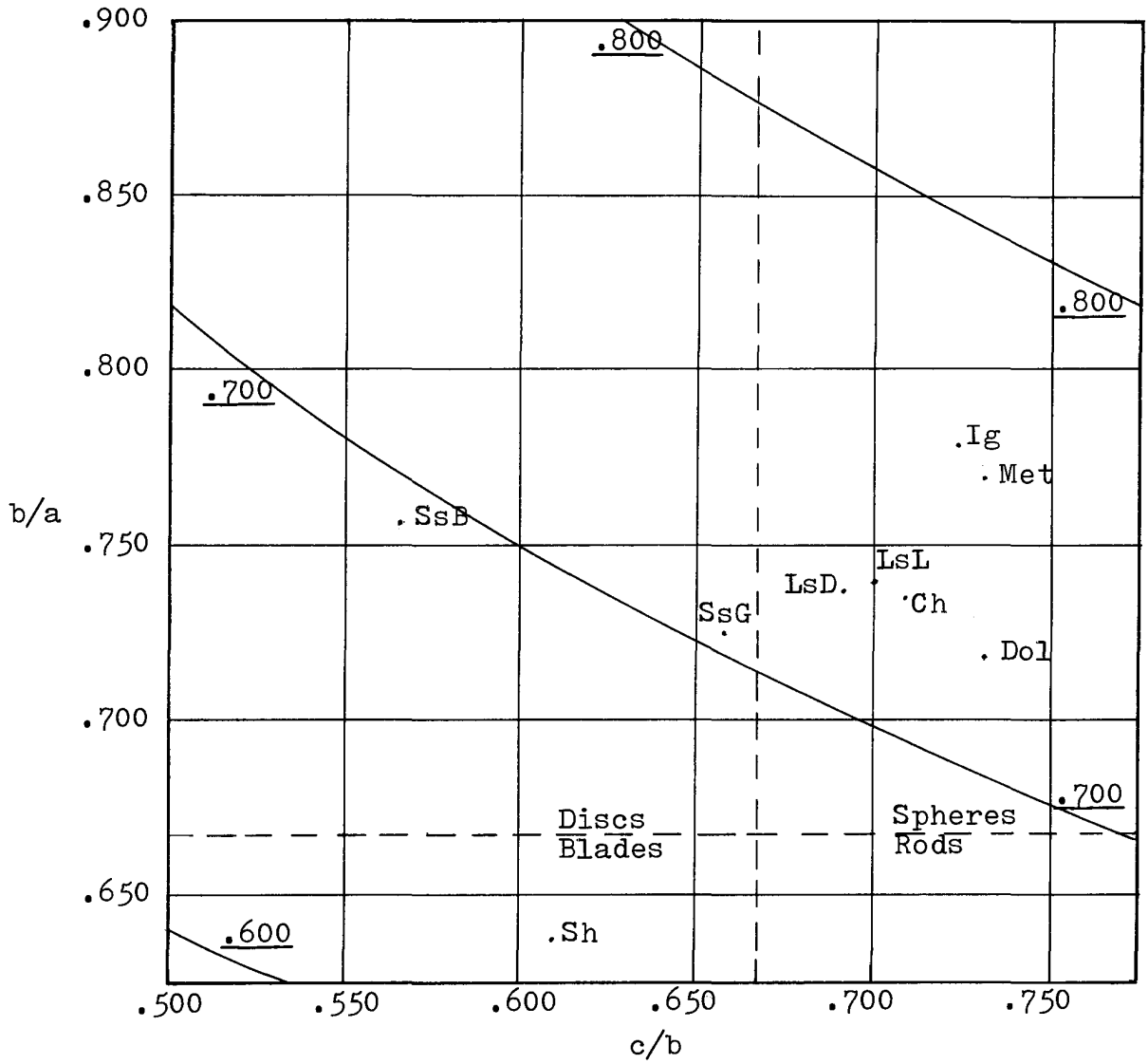
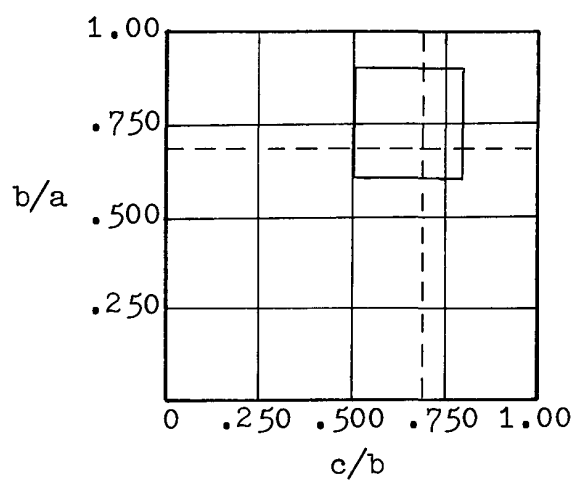
SsG . . . Sandstone (Gray)

PLATE IV

MEAN SPHERICITY

LOCATION III





EXPLANATION

Ch . . . Chert
Dol . . . Dolostone
Ig . . . Igneous
LsD . . . Limestone (Dark)
LsL . . . Limestone (Light)
Met . . . Metamorphic
SsB . . . Sandstone (Brown)
SsG . . . Sandstone (Gray)
Sh . . . Shale

mean sphericity for shale was .635 and near the border between blades and discs. The sandstones were the least consistent being more spherical toward the upper layers at Locations II and III. The shale was more bladed toward the upper layers at Location III. The carbonates were also sphere shaped with a mean sphericity of .743 and were consistent at each location but Location II. The anomaly was attributed to the lower number of pebbles collected at this location.

Summary and Conclusions

The Illinoian kame terrace remnant in Bremen Creek is 44.29% carbonates, 41.43% clastics and 14.28% crystallines. The average roundness of carbonates is .53, clastics .63, and crystallines.59. The carbonates and crystallines are generally spherical in shape whereas the clastics, because of bedding planes, are disc-shaped.

The results of this study along with similar investigations into both Illinoian and Wisconsin gravel deposits will definitely be helpful in understanding the glacial geology of Ohio. Stone counts, lithology data, and topography are probably the most useful to identify individual terraces and general trends, such as flow direction of meltwater and local direction of ice movement. In some cases, as with the Gowganda tillite, direction of ice movement can be calculated.

Roundness and sphericity data are most useful in determining the distance pebbles have traveled in meltwater and in identification of lithology. More research is needed to prove its value in terrace identification.

PLATE V

Fig. I - Illinoian Kame Terrace - Direction: South
Location I - Center
Location II - Top Center

Fig. II - Illinoian Kame Terrace - Direction: West
Location I - Center

PLATE VI

Fig. III - Illinoian Kame Terrace - Direction: Southwest
From Adjoining Field - Location III - Center

Fig. IV
Direction: Northeast
Bremen Valley
Gravel Separator Center

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